

# Radioprotection and Radioactive Waste

Romão Trindade

The Radioprotection and Radioactive Waste Group (GRRR) has pursued its involvement in KADRWASTE (FCT), ACSPET (FP7) PETRUS II (FP7), JRP06 Increasing cancer treatment efficacy using 3D brachytherapy (EURAMET) and Ionizing Radiation Metrology for Metallurgical Industry (EMRP) research projects.

Members of the Group were continuing to be involved in several national and international committees, working groups and task forces related to radwaste management, transport of radioactive materials, radiological protection and monitoring, surveillance of contaminated scrap metal and radiological emergencies.

During 2011 and considering ITN's legal obligations, **135** requests for collecting and storing radioactive waste, from medical, industrial and research applications, were received and processed. To do these activities, GRRR has only one person, despite the efforts done in order to have the necessary personnel.

Also related to legal obligations, the Group has issued **532** licensing for medical, industrial, teaching and research applications. This year, **458** gamma spectrometric analyses for research, radiological protection and monitoring purposes were carried out at the Radioactive Samples Measurement Laboratory (LMAA/GRRR).

Despite financial and personnel restrictions, ITN's Treatment Station, the ECoDELi,R, used to monitoring radioactive liquid effluents discharges into the Borough treatment station, still pursues introduction of BAT at various levels, in order to increase a greater compliance with Artº 35º of Euratom Treaty recommendations.

The *Campus* environmental gamma radiation dose continued to be assessed through the gamma monitoring network, GAMMANET, and the data reported in compliance of Artº 35 of Euratom Treaty. Detection of radioactive materials in scrap metal is still continued and this year, **16** events requested GRRR intervention.

Radiological surveillance was carried out by GRRR during the stay of **4** military nuclear vessels in the Lisbon Harbour.

This year, **41** radiological verifications and monitoring of radiological facilities and equipment were also performed.

The Monitoring Programmes of the radioactive liquid discharges from public and private nuclear medicine facilities into the public sewage of Lisbon as well as the monitoring of the four ETAR'S (Lisbon City waste water treatment facilities), was as continued in 2011, in collaboration with Lisboa Council Borough .Concerning Education & Training, a Ph.D. degree in the field of radioactive waste management in collaboration with Sciences Faculty of Lisbon (Dpt. Geology) is in its writing phase. One M.Sc. in research on trends in radioactive discharges from Nuclear Medicine establishments with Escola Superior de Tecnologias da Saúde de Lisboa, is also in its writing phase.

Members of the GRRR have participated in a total of 17 different E&T actions, as lecturers and invited professors in **4** Advanced and Post-Graduation Studies (Masters, and Graduation Seminars) at IST, FCUL, FCM/UNL and ESTSL in the field of radiological protection, radioactive waste management, transport of radioactive materials and radiological emergencies. They have also participated in **13** training courses for professional (graduate and specialised workers) on radiological protection and safety, through the Training Centre and upon external and internal request.

Members of GRRR were involved on the process of obtaining the accreditation for the gamma spectrometry using NaI(Tl) detectors technique (the request for granting is expected to be made in 2012), as internal auditors and members of the groups involved in the Quality Management System of UPSR.

\*New GRRR Coordination starting 18<sup>th</sup> July: Isabel Paiva and Luis Portugal

## Research Team

### Researchers

R. TRINDADE, Aux., Group Leader,  
(until 30<sup>th</sup> June)  
M.I. PAIVA, Aux., Group Leader,  
(Starting 18<sup>th</sup> July)

### Technical Graduate

L.M. PORTUGAL, Group Leader,  
(Starting 18<sup>th</sup> July)  
P. PEREIRA (Starting 5<sup>th</sup> December)

### Technician

J. VENÂNCIO

### Student

A. BAPTISTA

## KADRWASTE – Study of the Adsorption Mechanisms and Kinetics in Geomaterials and Their Structural Characterisation: Implications for Processes of Natural Attenuation of Heavy Metal Contamination and Radioactive Wastes Confinement

M. Abel<sup>1</sup>, A. Mateus<sup>1</sup>, I. Bobos<sup>2</sup>, I. Paiva, R. Trindade, P. Duarte, M. Reis, M. F. Araújo, M. J. Madruga, J. Mirão<sup>3</sup> et al.

The project KADRWaste (PTDC/CTE-GEX/82678/2006) has pursued in 2011 with the continuation of its tasks, the presentation of communications in national and international conferences and the submission and publication of papers. It finished in July 2011 and the Final Report was sent to FCT, September 2011. A memorandum related to the technical, scientific public and political implications of the KADRWaste and its further developments was sent to the Minister of Education and Science.

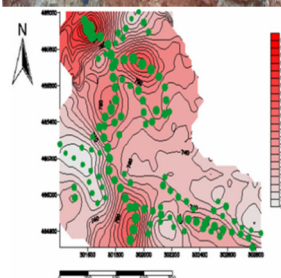
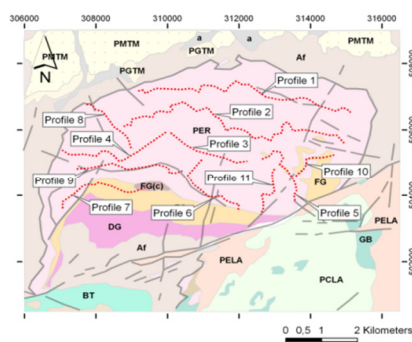
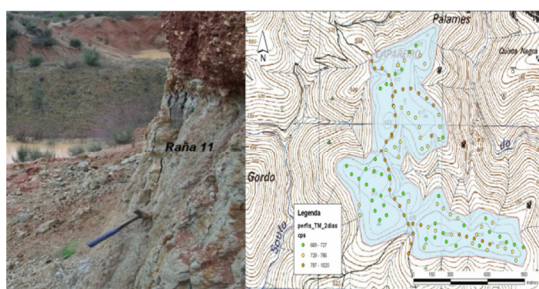
This project, Coordinated by Department of Geology of FCUL, has also, as members, Nuclear and Technological Institute (ITN), Department of Geoscience, Environment and Territorial Planning of FCUP, Department of Geosciences of UÉvora and the University of Bath (UK) as Consulting partner in the modelling tasks.

Three progress reports and the final report were delivered. From the 9 projected papers in international reviews, 3 have been published, 2 have been accepted for publication; 2 have been submitted, 2 are undergoing revision and 2 other papers are being finalized to be submitted in the first quarter of 2012. However, more experimental results are still in data treatment process. In terms of education and training, 3 Master Theses (ITN/FCUL; ITN/FCUP and ITN/U Aveiro) and 2 Post-Graduation Thesis (ITN/FCUL) were finished. One Ph.D. Thesis (FCUP) was concluded and another Ph.D. Thesis (ITN/FCUL) is still in preparation. The overall results of KADRWaste have open-up many collaborations, not only within the ITN (UPSR/UCQR/URSN) but also between ITN and the universities: FCUL, FCUP, U. Évora, U. Aveiro and U. Bath (UK).

KADRWaste was the first project to have in mind a scientific approach in order to reach a resolution for the disposal of radioactive wastes produced in Portugal. Besides the scientific results obtained in different areas, the main achievement was the establishment of a specific methodology for the characterization of a surface or near-surface repository adequate to the Portuguese situation.

The proposed methodology takes into account similar structures in other Countries, IAEA international recommendations and the implementation of the EURATOM Directives related to the safe management of radioactive wastes.

<sup>1</sup>(FFC/Geology/Creminer/FC/UL); <sup>2</sup>(ADFC/Geology/FC/UP); <sup>3</sup>(U. Évora)



### Published work

P. Duarte, A. Mateus, I. Paiva, R. Trindade, P. Santos: *Usefulness of systematic in situ gamma-ray surveys in the radiometric characterization of natural systems with poorly-contrasting geological features (examples from NE of Portugal)*, J. Applied Radiation and Isotopes, 69, 463-474, 2011.

**ACSEPT-Actinide reCycling by SEparation and Transmutation (7th Programme EURATOM- FP7-Fission 2007)**

*I. Paiva, J. Marçalo, C. Lourenço, R. Trindade, P. Vaz*

ITN has delivered two ACSEPT's progress reports (HYBAR's) in Domain 1, WP1.2, M 1.2.2, M1.2.4, D1.2.1. Experiments continued to be carried out at ITN/UCQR by the Inorganic and Organometallic Chemistry Group. Studies were performed by ESI-QIT/MS to probe the relative affinity of several N- and O-donor bases, building blocks of representative ACSEPT ligands (BTBPs, malonamides), towards several  $\text{LnX}_2^+$  ions ( $X = \text{NO}_3, \text{Cl}$ ). The ACSEPT grantee has been to Marcoule (CEA) working at ATALANTE Facility for 2 months, where she carried out ESI-QIT/MS experiments of the complexation of Am(III) with N-donor ligands and bases.

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**PETRUS II—Towards an European training market and professional qualification in Geological Disposal (Coordination and Support Action Project)**

*I. Paiva, P. Vaz, R. Trindade, et al.*<sup>1</sup>

PETRUS II has pursuing its activities in identifying existing EU training and education actions in radioactive waste management/geological disposal E&T and setting-up the recognition of European training programs on geological disposal based on the EFTS-FP7 (European Fission Training Schemes). A significant development from a pure training and mobility programme to one dedicated rather to structuring research training and researchers' career development across the EU, is the base of the new training scheme. Important issues are being dealt with such as address life-long learning and career development of experienced researchers in all areas of nuclear fission and radiation protection, touching upon both the public and the private sector. ITN has been supporting at the PETRUS II meetings the maximisation of transfer of higher level knowledge and technology with emphasis on multi-disciplinary and/or trans-national and inter-sectorial mobility to other partners, with nuclear industry, in transit to this energy option or in being trained and educated, independently of the future mix energy market. The public target has been clearly defined: research workers and industrial experts at least at post-graduate or equivalent level, i.e. from doctoral students to senior visiting scientists. Definition and testing of the different steps in the systematic approach to higher level training (e.g. analysis, design, development, implementation and evaluation) has been the core of the work of the last 24 months with an ultimate goal in mind: develop an *European passport for Continuous Professional Development*, which relies on the principles of modularity of courses and common qualification criteria, a common mutual recognition system, and the facilitation of teacher, student and worker mobility across the EU. This will only be possible by using the *European Credit system for Vocational Education and Training* (ECVET) that has already been launched by PETRUS II. PETRUS II will end up September, 14, 2012 and the final report will be delivered later on.

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<sup>1</sup>Partners: INPL, CU, TUC, MA, POSIVA, ANDRA, ARAO, RWRA, ITC, REESN, GRS, NDA

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**Characterization of Suitable Areas for a Long-Term Radioactive Waste Repository Facility in Portugal**

*P. Duarte<sup>1</sup>, I. Paiva, A. Mateus<sup>2</sup>, R. Trindade*

The work in progress is the core of a Ph.D. thesis being carried out in a collaboration between ITN/UPSR/GRRR and Department of Geology/FCUL. Part of the experimental work was carried out within the KADRWaste as one of the project's objectives. Ph.D. Thesis is in elaboration process.

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<sup>1</sup> In ITN until December 2009; <sup>2</sup> Dep. Geologia, FCUL.

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**Services****1. Radioactive waste management**

During 2011, **135** requests for radioactive waste collection were received, collected, segregated, and transported for the interim storage facility “Pavilhão de Armazenamento Interino de Resíduos Radioactivos”, (PAIRR) at ITN *Campus*. Concerning radwaste, continues to be very important and urgent to define and to establish a national plan related to radioactive wastes produced in Portugal. In the last years only one technician is working at PAIRR, which is not enough to carry out all duties

**2. Sealed sources licensing**

According Decree-Law nº 38/2007 and Decree-Law nº 165/2002, **532** sealed sources licensing were issued: national territory introduction licences (**133**), transfer licences (**90**), transport licences (**129**) and ownership licences (**180**). Only one person is related with this activity. It was developed a data base for radioactive sealed sources

**3. Gamma Monitoring Network (GAMMANET) of Instituto Tecnológico e Nuclear (ITN)**

The environmental dose gamma radiation at ITN *Campus* is continuously being measured by the gamma network, GAMMANET. The data are collected, analysed and reported to the EU, according to articles 35º and 36º of the Euratom Treaty and also to the National Report “Programas de Monitorização Radiológica Ambiental”.

**4. Radioactive Liquid Discharges from Hospitals in Public Sewage of Lisboa Borough Council (CML)**

Radioactive liquid discharges from public and private nuclear medicine facilities in Lisbon public sewage as well as residual effluents from Lisboa’s four Water Treatment Plants (ETARs) have been monitored in 2011. The Project was divided in 3 different programmes related to the sites where the samples were collected. Programme I involved sequential collection of discrete samples in sampling points from nuclear medicine facilities. In Programme II, discrete samples were taken at one single discharge point of each Lisboa’s ETARs. The Programme III has involved the affluent to ETAR’s and their effluents. Sampling was carried out in order to identify the radionuclides present and their activities. About 155 samples of liquid effluents were collected and analysed by quantitative and qualitative gamma spectrometry.

**5. Radioactive liquid discharges from Instituto Tecnológico e Nuclear (ITN)**

Radioactive liquid wastes originated at ITN are analysed and measured at “Estação de Controlo das Descargas dos Efluentes Líquidos Radioactivos” (ECoDELiR) before being discharged into Estação de Águas Residuais (ETAR). The data are reported to the EU according Articles 35º and 36º of Euratom Treaty and to the Radioactive Substances Committee of OSPAR Convention and also to the National Report “Programas de Monitorização Radiológica Ambiental”. In 2011 the work to improve ECoDELiR was pursued

**6. Radioactive liquid discharges from Instituto Português de Oncologia (IPO), Coimbra**

In 2011 and as requested by IPO-CROC, EPE, Coimbra, the radiological survey of radioactive liquid effluents from the IPO’s Medicine Nuclear Retention Tanks, was carried out by the Group before discharge into the public sewage.

**7. Nuclear vessels radiological monitoring**

Environmental radioactivity survey programmes consisting on continuous monitoring of radioactive aerosols and airborne radioiodine, sampling of water, sediments and biological species for gamma spectrometry analysis were carried out when nuclear vessels reach the Portuguese harbours. This year, **4** nuclear vessels stayed at Portinho da Costa harbour and estuary of Rio Tejo. The reports were sent to Ministry of Defence.

**8. Radioactivity in scrap metal**

In 2011, and as result of radiological surveys requested by the smelting industry, **16** events related to the detection of radioactive materials in scrap metal at smelting factories have been reported. The material collected has been stored at Pavilhão de Armazenamento Interino de Resíduos Radioactivos, (PAIRR) as radioactive waste. Reports were sent to the smelting company.

**9. Radiological protection and safety verifications and monitoring**

During 2011, GRRR has carry out **458** gamma spectrometry analysis and **41** verifications and monitoring concerning radiological protection and safety at medical and industrial facilities. The technique of gamma spectrometry using NaI(Tl) detectors has applied for the accreditation under the ISO/IEC 17025. The audit will be due in 2012.